Combustion Performance Improvements with CI-α Burner and Micro-Pulverized Coal Pulverizer

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Summary

Coal is the mainstream choice of fuel for newly-established thermal power stations in Japan because of the low price and stable supply due to the wide range of producing countries and the large reserves of coal used as fuel. However, compared with oil or gas firing, coal firing produces high levels of NOx and unburnt combustibles due to its fuel properties. Concerns over environmental problems such as global warming and acid rain have been increasing in recent years. Not only new but also existing thermal power stations will be required to produce less pollution by decreasing NOx levels as well as to enhance efficiency by decreasing the amount of unburnt combustibles in fly ash. In order to respond to such requirements, advanced low NOx burner, named CI-α (CRIEPI-IHI Advanced Low Pollution High Ability) burner, and micro-pulverized coal pulverizer have been newly developed.

CI-α burner has been developed by optimizing construction of burner nozzle against IHI's conventional low NOx burner (DF burner). DF burner is a swirl stabilized one with two swirling streams of combustion air divided by a cylindrical plate. The intensity of each swirl is controlled by individual resister vanes. These make it possible to form an internal circulation flow of hot gas from the inside of the furnace to the burner. The optimization promotes to form a larger internal circulation flow. As the result of pilot-scale tests using CI-α burner with a capacity of 1.5t/h, it was confirmed that NOx extremely decreased because of an early release in volatile nitrogen as well as acceleration in the reducing reaction. It was also confirmed that unburnt combustibles in fly ash decreased because of an increase in residence time in high temperature area. Based upon these results, the first CI-α burners have been installed to an industrial boiler in 1999.

On the other hand, we have established the micro-pulverized coal combustion technology. The development of a high performance coal pulverizer was most important in order to establish it. The micro-pulverized coal pulverizer has been developed by adopting a dynamic classifier and by optimizing construction of the classifier, grinding rollers and table against a conventional vertical roller pulverizer. Such an adoption and optimizations brought a improvement of fineness of pulverized coal. Under a normal operation, coal is pulverized to 70-80% passage through a 200 mesh (75μm) sieve. In comparison, the micro-pulverized coal pulverizer can pulverize coal to 95% passage through a 200 mesh sieve with keeping normal pulverization capacity. By the improvement of fineness, unburnt combustibles remarkably decrease because of improvement of char burnout. NOx also decreases because of an early release in volatile nitrogen as well as acceleration in the reducing reaction. As the result of tests at 700MW pulverized-coal fired unit, above-mentioned effects of micro-pulverized coal firing were demonstrated. It was also made clear that if micro-pulverized coal firing was adapted to 700MW pulverized-coal fired unit, annual running costs could be reduced by 136 million yen. The first installation of micro-pulverized coal pulverizers was to an industrial boiler and their superior pulverization performance was confirmed in 1997.

These two technologies were combined for the successful use of low-volatile coal such as anthracite or semi-anthracite in wall firing boiler. Modification was performed on CI-α burner by installing the air/coal adjuster in order to improve the flame stability. Pilot-scale combustion tests were conducted for several kinds of low-volatile coal, and it was confirmed that semi-anthracite with fuel ratio of less than six could be utilized in the same firing system for bituminous coal.

These advanced technologies, CI-α burner and the micro-pulverized coal pulverizer, will make it possible for users to expand coal types used at pulverized coal-fired units, and also help users to run with low pollution, high efficiency and low cost.